

HSC3103 – RESEARCH DESIGN AND EPIDEMIOLOGY

TUTORIAL 9

NON-PARAMETRIC TESTS

LEARNING OUTCOMES

- Understand applications of common statistical tests
- Determine the most appropriate analysis for your data
- Learn how to perform alternative statistical tests

OVERVIEW

The purpose of this tutorial help you identify and perform the most appropriate statistical test for your project data. We will be examining three types of tests over Weeks 7 to 9:

- Week 7: T-tests and ANOVAs
- Week 8: Correlation and Regression
- Week 9: Non-parametric tests

Each week we will examine the theory behind each test in detail, however, if you have determined you require a different test to the topic of the week, the resources can be made available to you if required. The more commonly required tests are covered in earlier weeks to minimise this being necessary however.

PART 1: Identifying an Appropriate Statistical Test

Purpose

Collected data alone cannot answer a research question. As seen in Week 6, data must be managed, analysed and finally interpreted. As correct tools are required to measure data, the correct test must be selected to analyse data. This week we will identify whether one of the t-tests or an ANOVA is appropriate for your data.

Activity 1: Identifying an Appropriate Statistical Test

If you have previously determined that none of the tests explored in Week 7 (t-tests and ANOVA) or Week 8 (correlation and regression) were suitable as an analysis method, discuss remaining potential options including:

- *Chi-squared test*: nominal data, commonly used for examining preferences
- *Spearman's rank correlation*: examining trends in ordinal data
- *Non-parametric variants*: non-parametric versions of most parametric tests exist

PART 2: Options for performing non-parametric tests

Purpose

As we examined in the previous tutorial, Microsoft Excel is a common spreadsheet program which can be used to perform a variety of calculations, create a range of graphs and perform basic analyses, however, the standard Analysis ToolPak does not perform non-parametric tests. In this section we will examine other available options.

Activity 1 – Non-parametric tests on VassarStats

VassarStats (vassarstats.net) is website which performs a variety of statistical analyses programmed in JavaScript and has an accompanying online textbook for all tests offered.

The website offers all standard parametric tests, often allowing either direct entry of data, or copy-paste of data sets. When first accessing the website, all available tests appear on a menu on the left (see Figure 1). Although there is a limited selection, most non-parametric options can be found under the “Ordinal Data” option.

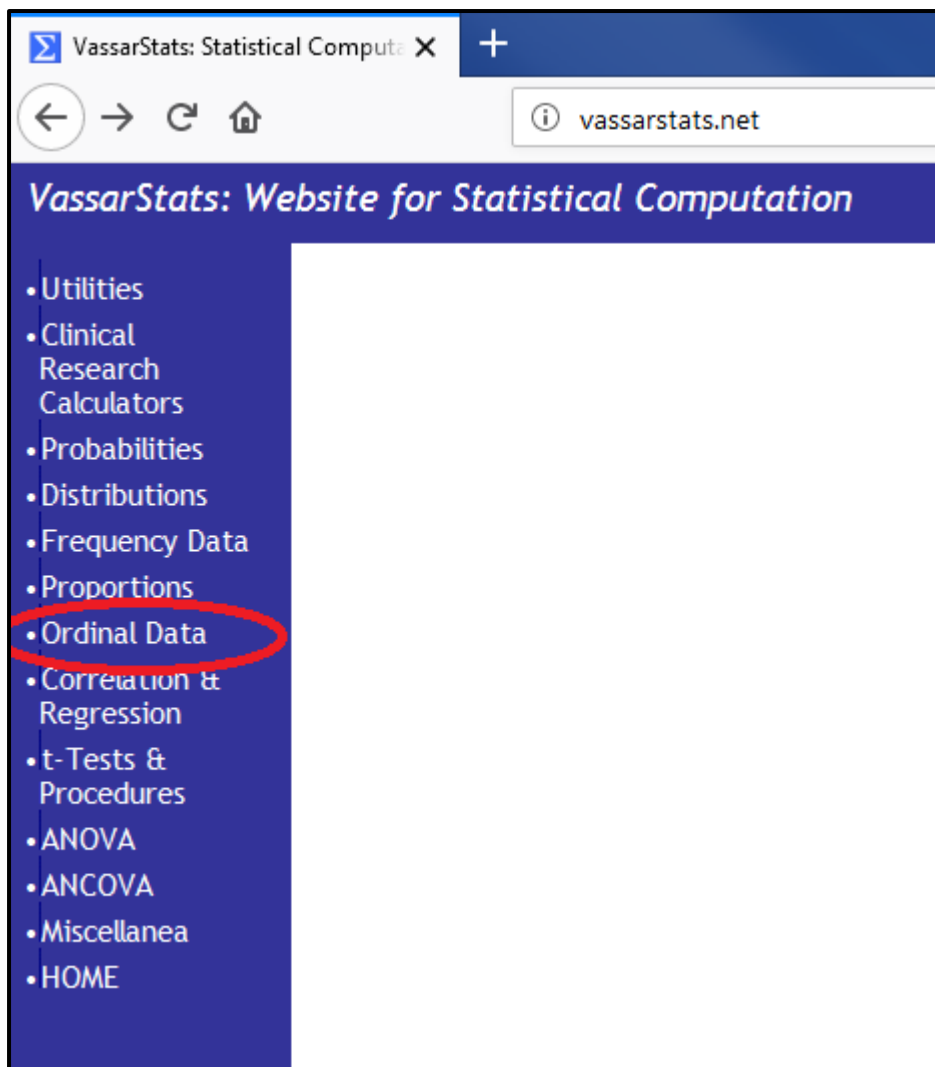


Figure 1: VassarStats home menu

Once you have accessed the “Ordinal Tests” menu, you will see all available option, associated descriptions, conditions and limitations (see Figure 2). For the following example we will select “Rank Order Correlation”

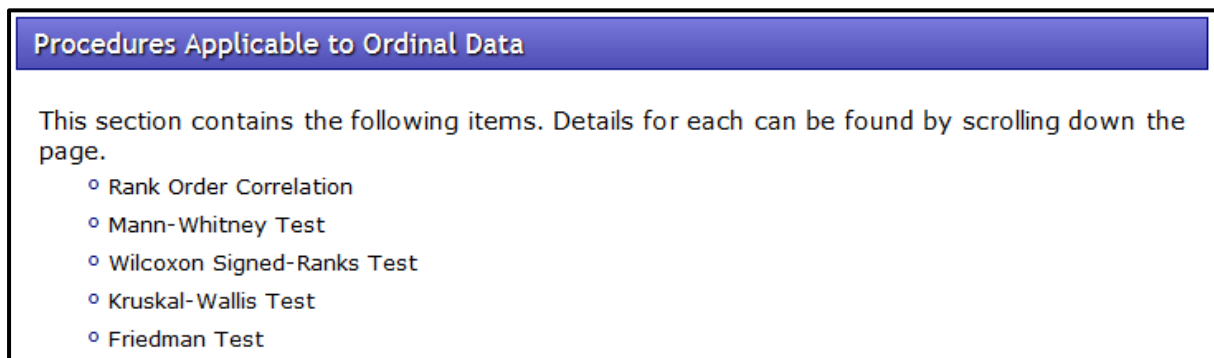


Figure 2: Ordinal Tests (non-parametric) available on VassarStats (as of April 2019)

As with most VassarStats options, when you first select a test you will be required to input the sample size (n) before progressing with any other options (see Figure 3) as this allows the website to configure the forms correctly. Please note, if you change your sample size, or make an error, you will have to start over.

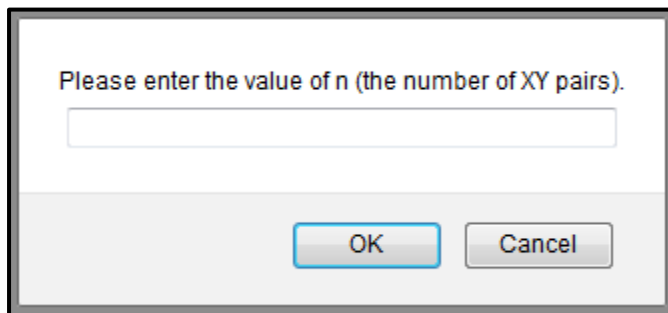


Figure 3: Sample size input for “Rank Order Correlation”

Once the sample size has been input, the website will generate a page for the test with the exact number of required cells to perform the calculation. Data input for this particular test allows you to enter by ranks, direct entry of raw data (i.e. into cells, from which ranks are then calculated), or data input (i.e. copy-paste from Excel or similar) (see Figure 4). To analyse the data, click the calculate button that matches your input method. Your data output will appear in the labelled cells below the input cells (see Figure 5).

Data Entry

pairs	Ranks for		Raw Data for		Data Import
	X	Y	X	Y	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Figure 4: Data input options for “Rank Order Correlation” on VassarStats

n	r _s	t	df
p	one-tailed		
	two-tailed		

Figure 5: Data output cells for “Rank Order Correlation” on VassarStats

Activity 2: Manually calculating Chi-squared tests

Chi-squared tests are not available in the programs we have explored but the test itself is rather easy to calculate by hand. The formula for a chi-squared test is rather simple to perform and interpret (see Stewart, 2016; pp-83-88). If you believe a chi-squared test would be appropriate for your data, please contact your tutor to guide you through the steps required.

$$\chi^2 = \sum \frac{(\textit{Observed} - \textit{Expected})^2}{\textit{Expected}}$$

Activity 2 – Alternate Programs

Microsoft Excel is a retail program, however, free alternatives do exist which share similar functions and even similar (or identical) commands. Issues may arise due to incompatible file types between software packages. Options include:

- Apache OpenOffice
 - Open Source office productivity software
 - Excel equivalent is “Calc”
 - <https://www.openoffice.org/>

- LibreOffice
 - Open Source office productivity software
 - Excel equivalent is “Calc”
 - <https://www.libreoffice.org/>

- Google Sheets
 - Cloud-based office productivity software
 - Requires Google account to edit files
 - <https://www.google.com/sheets/about/>

Another non-spreadsheet option is **VassarStats**; a website which performs a variety of statistical analyses programmed in JavaScript and has an accompanying online textbook for all tests offered.

- <http://vassarstats.net/>

Please note this is not an official Vassar College website, but the name is used with permission; the website’s author (Dr Richard Lowry) is an Emeritus Professor in Psychology who was based at Vassar College at the time of its development.

REFERENCE LIST

Stewart, A. (2016), *Basic Statistics and Epidemiology: A Practical Guide* (4th Edition) (pp 83-88). Boca Raton, FL: CRC Press